EVALUATION OF CONSOLIDATION PROBLEMS IN THICKER PORTLAND CEMENT CONCRETE PAVEMENTS

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RESEARCH

Introduction

Minimizing the amount of entrapped air in concrete is necessary to produce quality concrete with a longer pavement performance life, lower maintenance costs and fewer delays to the roadway users. Good quality concrete with low entrapped air content will have a higher strength and lower permeability than concrete with a considerable amount of entrapped air voids.

Project Objective

The purpose of this study is to investigate methods of reducing the size and total volume of the entrapped air voids in concrete slabs that are over 9-in thick. Cores taken from PCCP slabs have shown many entrapped air voids in the top few inches on some projects. The concrete meets density specifications but the large voids are likely to affect the long-term performance by making the concrete weaker and more permeable. Variations in vibration and aggregate gradation were investigated through laboratory and field tests. Their effect on void content, strength, and performance factors such as smoothness, faulting, adhesion failures, and spalling was investigated.

Project Description

A field trial was initiated to compare the effects of mix gradations and vibration frequency on core density. Four 152-m (500-ft) test sections of 266.7-mm (10.5-in) thick concrete were constructed, two with an increased proportion of coarse aggregate and two sections with a standard job mix concrete with the standard vibrator frequency was used for one section of each mix, and the vibration frequency was increased about 8 percent on the other. Later another test section was added to assess the effect of controlling the total gradation of concrete aggregate and increasing vibration frequency.

Surveys of joint sealant failures, spalling and joint faulting were performed annually for 8 years on the original test section. Core samples were taken and nuclear density meters were used on both projects to measure the in-situ density of the pavements. Core samples from the first project were analyzed to determine entrained and entrapped air content.

Project Results

Increasing the proportion of coarse aggregate in the mix consistently reduced the amount of entrapped air in these pavements without significantly affecting other performance parameters. Increasing the vibration frequency increased adhesion failures, spalling, faulting and entrapped air content of the standard mix. Although increasing vibration frequency did improve the initial smoothness of the uniform-gradation mix, the markedly detrimental effects on the standard mix and the lack of significant performance improvements on the other mixes argues against further use of this technique on thicker portland cement concrete pavements without further study. Using a more-uniformly-graded aggregate and a larger-sized coarse aggregate should result in better consolidation of thicker portland-cement concrete pavements.

Report Information

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